SPH4U: Work, Conservation of Energy Problems

Work-Energy Theorem

For each of the situations described below, indicate whether there is **no work**, **positive work**, or **negative work** being **done on the <u>object</u>**, and briefly explain your answer.

Situation #1:	**Situation #2**	**Situation #3**
You apply a force of 500 N to push around **<u>a shopping cart</u>** at a constant speed of 1.5 m/s for an hour.	A **<u>heavy box</u>** of mass (20 kg) slides to a stop (due to friction) from 3.5 m/s over a displacement of 12 m.	A waitress carries **<u>a 2 kg tray of plates and glasses</u>** at the same height for 35 m.
No work, positive work or negative work?	**No work, positive work or negative work?**	**No work, positive work or negative work?**

Conservation of Energy: Amusement Park Physics

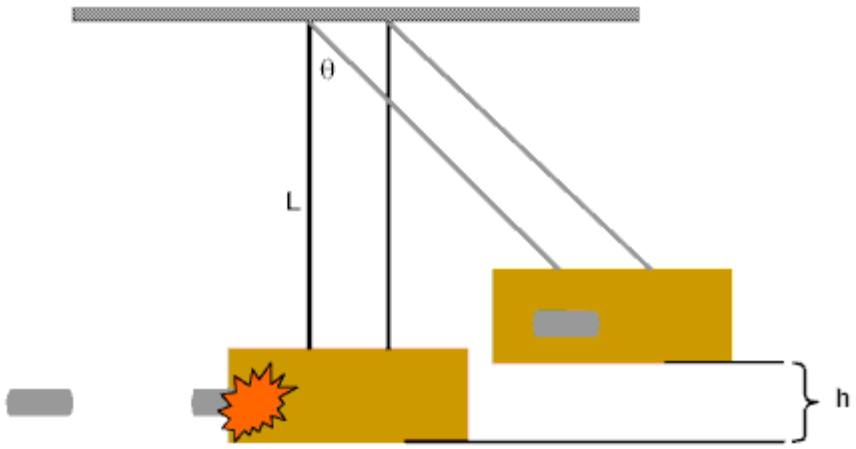
Sara, Alice and Courtney are on the amazing new Physics-Loop-Of-Death ride at Canada's Wonderland. Sara notes that the ride is frictionless and operates by gravity alone, Courtney measures their velocity at the bottom of the loop to be 20 m/s, and Alice notices, while eating cotton candy, that their car is motionless at the top.

Using the principle of the conservation of mechanical energy (total energy = gravitational potential energy + kinetic energy), calculate the height of the ride. (Show that you do not need to know the mass of the car and occupants to do this calculation!)

Conservation of Momentum + Conservation of Energy: CSI Rosedale

Adam and the tech crew are measuring the speed of bullets for a drama production, using a ballistics pendulum (as shown below). Jack, with keen eye and steady nerves, fires the bullet horizontally into a block of wood suspended by 2 light strings. The bullet remains embedded in the wood (i.e. an inelastic collision) and the wood and bullet together swing upwards.

The bullet is of mass *m* with an initial velocity *v*, the block is of mass *M*, and the block and bullet together swing up a vertical height *h*.



(a) If the horizontal momentum of the bullet-block system is conserved during the collision, derive an algebraic expression for the speed of the bullet-block immediately after the collision.

(b) Using the expression that you derived above, along with energy conservation principles, derive an expression for the speed of the bullet *v* in terms of *m*, *M*, *g* and *h*.

(c) If a bullet of mass 8.7 g hits a block of mass 5.212 kg, and the bullet and block swing up to a height of 6.2 cm, what is the initial speed of the bullet? (6.6×10^2 m/s)